A field guide to the NVC – Part 6: lowland dry acid grassland

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Parched acid grassland at Browndown SSSI, Gosport , 9 June 2019. *Photographs by the author*

Introduction

This completes my series of articles on the National Vegetation Classification (NVC) grassland communities. In past issues of *Flora News* I wrote a general introduction to grasslands and covered dry neutral grassland (*Flora News* No. 50, January 2016), wet grassland and rush pasture (*Flora News* No. 51, September 2016), calcareous grassland (*Flora News* No. 53, September 2017) and wet brackish grassland (*Flora News* No. 56, January 2019). The present article describes the core communities of dry acid grassland in the lowlands of Britain. To keep this reasonably concise I have not covered certain types of acid grassland that fall within the sand dune vegetation and maritime cliffs chapters (Rodwell 2000), although these are either absent from Hampshire or very limited in their extent. I have also omitted a few other less frequent types which I may tackle at a later date. In a future issue of *Flora News* I hope to publish a detailed account of my proposed new community nicknamed '*Geranium molle* grassland', mentioned in my article on acid grassland indicators in *Flora News* 57.

As usual I have given scientific names of vascular plants, now following Stace (2019), on the first mention of each species. Within each sub-community account I have given the average number of species per sample from the published NVC floristic tables.

Definition and ecology

Dry acid grasslands have an interesting and quite complex ecology, so the following is only a brief summary. For a more comprehensive account refer to Neil Sanderson's acid grassland review (Sanderson 1998), which is available on the Natural England website. It is also worth reading the introduction to the calcifugous grasslands and montane communities chapter of the NVC grasslands volume (Rodwell 1992), especially the Habitat section for U1, which is the predominant type of acid grassland in lowland Britain.

Lowland dry acid grassland is grassland that occurs on nutrient-poor, often freely draining soils, especially sands and gravels. These substrates are therefore usually base-poor and 'acidic', with a pH as low as 3 on heathland podzols, up to around 6–7 in other habitats. Lowland dry acid grassland is also often characterised by high levels of insolation, which can lead to parching of the vegetation during spells of warm, dry weather, especially by mid summer.

Dry acid grassland vegetation may be grass or herb dominated and may also support a variety of lichens and bryophytes. It occurs mainly on heaths and commons, coastal vegetated sand and shingle, abandoned sand and gravel quarries and sometimes along forestry tracks and on post-industrial land (where it can even develop on weathered calcareous substrates, such as asphalt). In most of these habitats it will typically receive grazing of some sort, be it by rabbits, deer or livestock, thereby preventing succession (and some might say degradation), to dwarf shrub heathland and scrub. Less acidic types of acid grassland sometimes occur in hard-grazed pony fields, public parks, churchyards and on road verges, though often only as localised patches within larger areas of neutral, moister (mesic) grassland.

A distinctive feature of many acid grasslands is their high level of disturbance. They are often subject to soil disturbance (from ants, rabbits and livestock), and also compaction and erosion (e.g. due to trampling by animals or people) and other biotic and environmental stresses. In combination with the summer parching this leads to the development of patches of bare ground, which provide an important habitat for the often characteristic annuals and ruderal species. Many of these are 'winter annuals' which typically develop over the late autumn to early spring period. Other well-represented groups of species in acid grassland are the slow-growing stress-tolerators with tough leaves (such as fescues *Festuca* spp.) and the hemicryptophytes with rosette leaves (e.g. Cat's-ear *Hypochaeris radicata*), both of which are resistant to trampling and grazing. Competitive, nutrient-demanding species are poorly represented in acid grassland because drought-prone soils restrict the growth and nutrient take-up of plants, even if nutrients are present in the soil.

The ability of acid grassland species to survive in dry, disturbed habitats means that several have also now found their way into the urban environment, particularly along road verges, kerbs and pavements. Some species which we regard mainly as urban 'ruderal' species are in fact acid grassland species (a good example being Whitlowgrass *Erophila verna*). There is also evidence that some acid grassland species are expanding their native ranges as a result of climate warming and a change to a more Mediterranean style of weather (wetter winters and warm, dry summers). Examples include species such as Early Meadow-grass *Poa infirma*, Clustered Clover *Trifolium glomeratum* and Knotted Hedge-parsley *Torilis nodosa*.

Floristics

Lowland dry acid grassland is typically dominated by Common Bent *Agrostis capillaris*, with variable amounts of Red Fescue *Festuca rubra*, Meadow-grasses *Poa* spp. and Sweet Vernal-grass *Anthoxanthum odoratum*. Other graminoids of heathy, more strongly acidic habitats include Bristle Bent *Agrostis curtisii*, Heath Grass *Danthonia decumbens*, Fine-leaved Sheep's-fescue *Festuca filiformis*, Heath Wood-rush *Luzula multiflora* and Pill Sedge *Carex pilulifera*. Wavy Hair-grass *Deschampsia flexuosa* is a feature of semi-upland heathy grassland, but requires damper conditions so is rarely found in open dry acid grassland in the south. In sandy or parched areas, annual grasses are distinctive, especially Squirrel-tail Fescue *Vulpia bromoides*, Soft Brome *Bromus hordeaceus* (sensu lat.), Early Hair-grass *Aira praecox* and Silver Hair-grass *A. caryophyllea*.

Sheep's Sorrel *Rumex acetosella* and Heath Milkwort *Polygala serpyllifolia*, Browndown Common, May 2018.

A large variety of herbs occur, but probably the most common and widespread are Sheep's Sorrel *Rumex acetosella*, Cat's-ear, Common Bird's-foot-trefoil *Lotus corniculatus*, Lesser Hawkbit *Leontodon saxatilis* and Ribwort Plantain *Plantago lanceolata*. Also characteristic, particularly on bare gravel and stony substrates, are the two native stonecrops,

Biting Stonecrop *Sedum acre* and English Stonecrop *S. anglicum* (the latter particularly in the south-west). Mossy Stonecrop *Crassula tillaea* is a characteristic species of heavily disturbed sites and is another species which is spreading in the UK. In certain situations Ragwort *Jacobaea vulgaris*, Common Nettle *Urtica dioica* and other taller weedy species may be locally frequent, including around rabbit burrows, where there may also be one or two species distasteful to rabbits, such as Ground-ivy *Glechoma hederacea*.

On heathy soils with low pH a suite of characteristic herbs appears, including Heath Bedstraw *Galium saxatile*, Slender St John's-wort *H. pulchrum*, Heath Milkwort *Polygala serpyllifolia*, Tormentil *Potentilla erecta*, Sand Spurrey *Spergularia rubra*, Heath Speedwell *Veronica officinalis* and Common Dog-violet *Viola riviniana*. These will often be joined by scattered, often grazed plants of Heather *Calluna vulgaris*, Bell Heather *Erica cinerea*, gorse species *Ulex*, bramble *Rubus* agg. and varying amounts of Bracken *Pteridium aquilinum*. Although more a feature of the west and north, woodland species such as Bluebell *Hyacinthoides non-scripta* and Wood Anemone *Anemone nemorosa* also occur in this type of acid grassland. Apart from Bracken, the only fern characteristic of acid grassland is Moonwort *Botrychium lunaria*, which is also primarily a northern and western species.

A large group of predominantly annual and ephemeral herbs is to be found on light soils, bare sand and more heavily disturbed or stressed areas. These include Slender Parsley-piert *Aphanes australis*, Little Mouse-ear *Cerastium semidecandrum*, Common Stork's-bill *Erodium cicutarium*, Smooth Cat's-ear *Hypochaeris glabra*, Small Cudweed *Logfia minima*, Upright Chickweed *Moenchia erecta*, Early Forget-me-not *Myosotis ramosissima*, Bird's-foot *Ornithopus perpusillus*, Annual Knawel *Scleranthus annuus*, Lesser Chickweed *Stellaria pallida*, Hare's-foot Clover *Trifolium arvense*, Hop Trefoil *T. campestre*, Knotted Clover *T. striatum* and Wall Speedwell *Veronica arvensis*. Several of these are particularly distinctive of pure sand and characterise the 'Thero-Airion alliance' type of vegetation which was not fully covered by the NVC (see further comments below, under U1).

Rather surprisingly, despite the frequent disturbance, acid grassland tends not to support many neophyte aliens, but one example is Pirri-pirri-bur *Acaena novae-zelandiae*, which is also mainly associated with sandy substrates. Some acid grassland species have a preference for coastal habitats, including Bulbous Meadow-grass *Poa bulbosa* and several of the clovers.

Herbs of more mesic (less water-stressed) mildly acidic grassland in man-made environments include perennials (some short-lived) such as Yarrow *Achillea millefolium*, Daisy *Bellis perennis*, Common Mouse-ear *Cerastium fontanum*, Dove's-foot Crane's-bill *Geranium molle*, Musk Stork's-bill *Erodium moschatum*, Buck's-horn Plantain *Plantago coronopus* and Lesser Trefoil *Trifolium dubium*, plus a variety of annuals, especially Annual Meadow-grass *Poa annua*, Early Meadow-grass, Spotted Medick *Medicago arabica* and Sticky Mouse-ear *Cerastium glomeratum*. These are all distinctive of '*Geranium molle* grassland'.

A further group of species occurs on both dry acidic and calcareous soils, including Sheep's Fescue *Festuca ovina*, Slender Sandwort *Arenaria leptoclados*, Harebell *C. rotundifolia*, Carline Thistle *Carlina vulgaris*, Field Mouse-ear *Cerastium arvense*, Stemless Thistle *Cirsium acaule*, Eyebright *Euphrasia* agg., Common Cudweed *Filago germanica*, Lady's Bedstraw *Galium verum*, Mouse-ear Hawkweed *Pilosella officinarum*, Hoary Plantain *Plantago media*, Autumn Lady's-tresses *Spiranthes spiralis*, Dandelions *Taraxacum* in section Erythrosperma and Large Thyme *Thymus pulegioides*.

Characteristic lowland acid grassland lichens include *Cladonia furcata*, *C. rangiformis* and *Peltigera* spp., especially *P. canina*, *P. hymenina* and *P. rufescens*. In heathy acid grassland other *Cladonia* species sometimes appear, together with *Cetraria aculeata*. Typical mosses found in various types of acid grassland include *Atrichum undulatum, Brachythecium albicans*, *Ceratodon purpureus*, *Dicranum scoparium*, *Hypnum cupressiforme* var. *jutlandicum* and var. *lacunosum*, *Polytrichum juniperinum*, *P. piliferum*, *Pseudoscleropodium purum*, *Rhytidiadelphus squarrosus* and *Syntrichia ruraliformis*.

Evaluation, conservation and threats

In the UK, acid grassland has been well-studied historically, especially in the Brecklands of East Anglia, but overall is rather poorly understood and under-appreciated (in marked contrast to calcareous grassland and dwarf shrub heathland vegetation). Rodwell (1992) noted that 'compared with their calcicolous counterparts' acid grasslands in Britain had '*commanded somewhat sporadic interest*'. In more recent times little appears to have been published on acid grassland ecology, conservation and management since Neil Sanderson's review (Sanderson 1998), which is now more than twenty years old, though still highly relevant. The account of U1 in

Vegetation of Britain and Ireland (Proctor 2013) is contained within just a single paragraph. In addition to the much greater attraction of ecologists to species rich calcareous grasslands in the past, the lack of recent study of acid grasslands is undoubtedly due to the more pressing concern for old hay meadows and other types of herb-rich neutral grassland which have undergone much more serious declines in the UK in recent decades.

The four dry acid grassland NVC communities likely to be encountered in lowland Britain – U1 to U4 – fall within the definition of Lowland Dry Acid Grassland Priority Habitat in the UK (Maddock 2011) and qualify as a Habitat of Principal Importance in England under S.41 of the Natural Environment and Rural Communities (NERC) Act 2006. Also included are two of the sand dune communities, SD10 and SD11, not covered by this article. These types correspond to Lowland dry acid grassland ('g1a') of the UK Habitat Classification (Butcher et al. 2020). Only one rare lowland type of acid grassland of inland dunes is protected by European legislation as a Habitats Directive Annex 1 habitat.

As well as often being floristically rich, lowland dry acid grassland is important nationally for supporting a large number of rare and declining plants, such as Maiden Pink *Dianthus deltoides*, Heath Lobelia *Lobelia urens* (both Vulnerable in England) and Prostrate Perennial Knawel *Scleranthus perennis* subsp. *prostratus* (Endangered). Certain types of acid grassland (particularly those on moister soils not subject to summer parching) are important for grassland fungi, especially waxcaps and earth-tongues. Lowland acid grassland is also immensely important for reptiles, spiders and many insect orders which require summer warmth and bare soil, especially Lepidoptera, Orthoptera, Hemiptera, Coleoptera and Hymenoptera. Further information on important species of acid grassland is given in the review by Sanderson (1998).

Acid grassland of Priority Habitat quality is widespread throughout England and parts of Wales, with the majority of sites found on heathlands, coastal habitats and disused sand and gravel quarries. Many sites are nationally and internationally protected by virtue of their inclusion within larger heathland or coastal vegetated shingle sites, whilst smaller areas may receive non-statutory protection within county wildlife sites and nature reserves. However, dry soils supporting acid grassland often make good building land so often come up for development. Many smaller sites are therefore being lost through housing development – especially pony fields, former quarries and sand pits and sites which are managed as amenity grassland. Unfortunately, these types of sites are being lost because acid grassland is inherently difficult to survey (see below) and many ecological consultancies do not employ experienced vegetation surveyors when carrying out initial 'Phase 1' site appraisals. Moreover, the latter are often undertaken out of season and tend to focus on identifying habitats which might support protected species (of fauna). Acid grasslands are therefore often overlooked completely, mis-classified or in some cases deliberately downgraded to 'improved' or 'semi-improved' grassland of lower ecological value to reduce the 'burden' of habitat mitigation or Biodiversity Net Gain on developers.

Surveying acid grassland

Acid grasslands are probably the most difficult lowland habitat type to survey in the UK, even for experienced vegetation surveyors. There are several reasons for this, including the difficulty in identifying plants vegetatively or in a stunted state and the fact that annual plants may be absent or not visible out of season or in certain years when weather conditions are not suitable for germination. Periods of drought and rainfall can affect the appearance of acid grassland considerably and can give a false impression of the lack of herb richness and quality of the sward.

Notwithstanding these limitations, a good botanist should be able to recognise acid grassland vegetation based on the presence of the more characteristic perennial species, provided that the survey is undertaken during the key season of early spring to early summer. It is useful to be able to recognise the commoner mosses listed above.

For a reliable survey at least two visits should be carried out, timed for early April and late May to June in southern England, depending on the mildness and wetness of the preceding winter. It is very difficult to distinguish acid grassland from dry neutral grassland outside the main May to June period, especially when the ground is parched or if the grassland has been recently mown. To obtain a comprehensive species list for an acid grassland site would take much more effort – at least three visits between early spring and late summer (a visit in August can be useful) – and ideally a number of visits spread out over several years.

Classifying and mapping acid grassland is also made rather difficult because of some problems with the arrangement of sub-communities within the main U1 type (see below), but more importantly because intermediate

(transitional) types with other neutral grassland communities frequently occur. On heathlands, there may be mosaics of acid grassland with heathland vegetation and there is the added problem of how to record Bracken and scrub cover.

Descriptions

Overview

The 12 acid grassland types dealt with in this article are listed in Table 1. They are all included in Volume 3 of Rodwell (1992) and comprise the four main NVC communities of lowland dry acid grassland (U1 to U4), three of which are divided into sub-communities, plus U20a (Bracken stands with acid grassland). Note that some additional sub-communities not listed in the table are predominantly upland or do not count as grassland, so are not covered in this article. Also omitted are SD10, SD11 and a few rare or localised types, including specialised communities of the Lizard Peninsula in Cornwall, a mainly coastal type characterised by *Sedum* spp. and Sheep's-bit, and 'Chamomile grassland'. I may look at some of these in future articles. The descriptions which follow are mostly based on the published accounts, but are supplemented by my own observations.

Table 1: Types of lowland acid grassland. Where scientific names have changed the current names (e.g. Stace Ed. 4 for vascular plants) are shown in square brackets.

NVC chapter	Community	Sub-community
Calcifugous grasslands and montane communities (Rodwell 1992, Vol. 3)	**U1** *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland	**U1a** *Cornicularia aculeata [Cetraria aculeata]-Cladonia arbuscula* sub-community
		U1b Typical sub-community
		U1c *Erodium cicutarium-Teesdalia nudicaulis* sub-community
		U1d *Anthoxanthum odoratum-Lotus corniculatus* sub-community
		U1e *Galium saxatile-Potentilla erecta* sub-community
		U1f *Hypochaeris radicata* sub-community
	U2 *Deschampsia flexuosa* grassland	**U2a** *Festuca ovina-Agrostis capillaris* sub-community
	U3 *Agrostis curtisii* grassland	(no sub-communities)
	U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland	**U4a** Typical sub-community
		U4b *Holcus lanatus-Trifolium repens* sub-community
		U4c *Lathyrus montanus [Lathyrus linifolius] -Stachys betonica [Betonica officinalis]* sub-community
	U20 *Pteridium aquilinum-Galium saxatile* community	**U20a** *Anthoxanthum odoratum* sub-community

U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland

Distribution and general characteristics

U1, also known as 'parched acid grassland' (Sanderson 1998) is the most common and widespread type in southern and eastern Britain. The NVC community and its six sub-communities were delineated on the basis of relatively few samples (*n* = 203) of which a large proportion were from historical data collected from the Brecklands of East Anglia. This has unfortunately caused some anomalies in the described types due to the inclusion of records of species characteristic of more calcareous sandy soils. Nevertheless, at least three of the six sub-communities are widespread outside of the Brecks and are reasonably well defined.

Some of the sub-communities of U1 are relatively species rich, and are on a par with some of the richer types of neutral and calcareous grassland in this respect. In the published floristic tables Rodwell (1992) gives the average number of species per sample over the community as 16, compared to 23 for MG5, but the 'true' figure for U1 could be nearer 20. The NVC data are likely to have been affected by sampling too late in the year to adequately record the earlier-flowering annuals, and may also have been influenced by some of the other factors mentioned above (see 'surveying acid grassland').

One important point to be aware of is that although included in the community name, Sheep's Fescue *Festuca ovina* is almost *never* found in typical examples of U1 in southern Britain outside of the Brecks. The nominate

subspecies *F. ovina* subsp. *ovina*, which according to Stace (2019) does occur mainly on acid soils, is 'very sparse' in south-central and south-east England. It seems that in these regions *F. ovina* is replaced by Fine-leaved Sheep's-fescue *F. filiformis* (formerly *F. tenuifolia*), particularly on more strongly acid soils. The NVC did not differentiate between *F. ovina* and *F. filiformis* and the name '*F. ovina*' should be regarded as an aggregate of these.

U1 is usually dominated by smaller, fine-leaved perennial grasses, especially Common Bent, Sweet Vernal-grass, Red Fescue and some *Poa* species. A number of other grasses may occur at low frequency, including tussocky or coarser species such as False Oat-grass *Arrhenatherum elatius*, Heath Grass and sometimes Yorkshire-fog *Holcus lanatus*. On more strongly parched and disturbed soils the predominant species are the annual Squirrel-tail Fescue, Early Hair-grass and Soft Brome *Bromus hordeaceus* (including subspp. *thominii* and *ferronii* in coastal areas). There are relatively few associated rushes, sedges and relatives, the more frequent being Field Wood-rush *Luzula campestris* (though often more characteristic of MG5), Prickly Sedge *Carex muricata* subsp. *pairae* and Spring Sedge *Carex caryophyllea*.

Sheep's Sorrel is the only herbaceous constant in U1, but even though perennial, this species is strongly dependent on regular disturbance to open up niches for it, so is not always visible in closed, mown turf. The other most frequent perennial herbs comprise Cat's-ear, Lesser Hawkbit and Ribwort Plantain, plus Common Bird's-foot-trefoil which is most characteristic of U1d. Heathy perennials are usually scarce or absent, except for Heath Bedstraw and Tormentil which occur in U1e.

Annual species help to characterise the community, and are most diverse and numerous in U1c. The most frequent annual herbs across the community as a whole are Common Stork's-bill, Slender Parsley-piert, Wall Speedwell, Bird's-foot and the two Forget-me-nots *Myosotis discolor* and *M. ramosissima*. It is worth noting that there is a distinctive community of annual grasses, herbs and mosses on pure, often unconsolidated sand, which can include most of the annual listed under Floristics (above), but is especially characterised by Silver Hair-grass, Hare's-foot Clover, Bird's-foot and Small Cudweed. This type of acid grassland falls within the continental Thero-Airion alliance, which Rodwell noted had been omitted from the published NVC (Rodwell et al. 2000, Rodwell et al. 2007), although it is partially covered by MC5 *Armeria maritima-Cerastium diffusum* maritime therophyte community. In their review of the NVC coverage Rodwell et al. (2000) suggested that possibly three additional Thero-airion communities 'ephemeral vegetation of bare but stable acid sands and rock outcrops' should be recognised. I have not delved into these any further in this article, but they are occasionally encountered in Hampshire, particularly in old sand pits and on sandy heathland sites. Interestingly, Neil Sanderson (pers. comm.) is of the opinion that U1a, U1b, U1c and the drier forms of U1e and U1f all belong in the Thero-Airion, whilst U1d and the damper U1f fall under the more mesotrophic Plantagini-Festucion grasslands.

If undergrazed or neglected, U1 can become strongly dominated by fescues, especially Red Fescue, which forms small but very dense tussocks. A few herbs may still be visible, growing in gaps between the tussocks or where there has been some disturbance by rabbits, especially Sheep's Sorrel and Common Bird's-foot-trefoil, but annuals and ephemerals may be scarce. Pleurocarpous mosses may also form a dense ground layer in longer swards, particularly *Pseudoscleropodium purum*. Species poor stands are generally placed under the U1b Typical sub-community; richer stands tend to fall under U1d or U1f.

Sub-communities

U1a *Cornicularia aculeata [Cetraria aculeata]-Cladonia arbuscula* sub-community is a lichen-rich type of highly stressed vegetation on very nutrient poor sandy substrates. It is largely confined to the Brecklands of East Anglia, but also occurs at Dungeness in Kent and Woolmer Forest in Hampshire where there is a nationally important stand of it. It is a very herb poor sub-community, dominated by Sheep's Fescue (sensu lat.) with frequent Sheep's Sorrel, but only scattered plants of other acid grassland species. The lichens mainly comprise *Cladonia* species, especially the 'Reindeer mosses' in the *Cladina* section, especially *Cladonia arbuscula*, *C. ciliata* and *C. portentosa*, and also *Cetraria aculeata*, which is included in the sub-community name, and *Peltigera* spp. Note that some types of U1 can support the commoner *Cladonia furcata* and *C. rangiformis* at high abundance, but to qualify as U1a some of these characteristic species need to be present.

Mosses are also well-represented, with the more frequent comprising *Polytrichum juniperinum*, *P. piliferum*, *Dicranum scoparium* and *Hypnum cupressiforme* var. *lacunosum*, often with *Syntrichia ruraliformis* and

Brachythecium albicans in unconsolidated sand. Small areas of U1a also probably occur in the New Forest, and vegetation resembling this is present on Browndown in Gosport, although here the lichens are mostly subordinate to the mosses, probably partly due to trampling. Interestingly, Rodwell (1992) notes that the moss *Campylopus introflexus* can be seen in some stands of U1a. This introduced species was first found in the UK in 1941 and would have still been relatively scarce when the NVC work on U1 was carried out (but is now abundant everywhere on dry heathland). NVC floristic table: average 14 species per sample; range 7–20.

U1b Typical sub-community is the 'standard' type of U1 on moderately acidic, moderately dry and lightly disturbed soils. It is often rather strongly grass-dominated (particularly by Common Bent and Sweet Vernal-grass) and can look rather 'semi-improved', but it varies from herb poor to moderately herb rich. It usually supports most of the characteristic U1 herb species, Sheep's Sorrel and Ribwort Plantain being the most frequent. It also may support some of the weedy and mesotrophic species, such as Ragwort *Jacobaea vulgaris*, Yarrow and Common Mouse-ear *Cerastium fontanum*. Typical annuals include Squirrel-tail Fescue, Early Hair-grass, Slender Parsley-piert and Common Stork's-bill. Mosses are usually not prominent, though Rodwell notes that *Brachythecium albicans* is sometimes quite extensive. Neil Sanderson (pers. comm.) notes that U1b is local in the New Forest where it occurs on soils too winter dry and/or acid to support U1f, but is probably more frequent on the drier Wealden sands. NVC floristic table: average 13 species per sample; range 5–27.

U1c *Erodium cicutarium-Teesdalia nudicaulis* sub-community is described by Rodwell (1992) as the 'richest and most striking kind' of U1 grassland. As with U1a it is particularly characteristic of Breckland and described on the basis of historical data from that area, so small differences are observed in other regions, including the absence of Crested Hair-grass *Koeleria macrantha* and rarities such as Breckland Thyme *Thymus serpyllum* (unsurprisingly) and Purple Milk-vetch *Astragalus danicus*. It is worth noting that although included in the sub-community name, Shepherd's Cress *Teesdalia nudicaulis* is rather uncommon in the sub-community, at least in Hampshire, and may be absent from many examples; it also occurs in three of the other sub-communities, so its presence is not necessarily diagnostic of U1c. U1c is much more widespread outside the Brecks than U1a, and may be at least occasional in Hampshire, particularly around the coast at places like Hayling Island and Gosport, as well as inland in north-east Hampshire and the New Forest. NVC floristic table: average 24 species per sample; range 15–35.

U1a lichen heath, Woolmer Forest, September 2012.

Shepherd's Cress *Teesdalia nudicaulis*

Thus, the 'non-Breckland' U1c is composed of mixtures of the main perennial and annual grasses (Common Bent, Red Fescue, Sweet Vernal-grass, Squirrel-tail Fescue and Early Hair-grass), the typical U1 herbs (including Sheep's Sorrel, Cat's-ear and Ribwort Plantain) with a wide variety of the other associated species, especially the annuals and ephemerals which help to make the sub-community distinctive. Amongst the more frequent of these are Slender Parsley-piert, Sandwort spp. Common Stork's-bill, Whitlowgrass, Smooth Cat's-ear, Small Cudweed, Changing Forget-me-not, Early Forget-me-not, Bird's-foot, Lesser Chickweed and Wall Speedwell. Trefoils, clovers and other legumes are sometimes also frequent, especially on the coast or on slightly base-rich gravelly substrates. These include Lesser Trefoil, Hop Trefoil, Bird's-foot Clover *Trifolium ornithopodioides*, Knotted

Clover and more rarely Slender Bird's-foot-trefoil *Lotus angustissimus*. Bulbous Meadow-grass *Poa bulbosa* is possibly also characteristic of this sub-community.

Most of the typical U1 species of mosses occur in U1c in variable quantity, with the most frequent being *Polytrichum juniperinum*, *Brachythecium albicans*, *Ceratodon purpureus*, *Hypnum cupressiforme* var. *lacunosum* and *Syntrichia ruraliformis*.

U1d *Anthoxanthum odoratum-Lotus corniculatus* sub-community develops on more mesic, i.e. moister soils where summer parching does not exert so much influence. It therefore tends to look more like neutral grassland and indeed examples usually show some degree of transition to **MG5c** *Cynosurus cristatus-Centaurea nigra* grassland, *Danthonia decumbens* sub-community. It is also quite similar to U1f (see below). Yorkshire-fog often occurs in addition to the main U1 grasses and is preferential to the sub-community. Sweet Vernal-grass and Common Bird's-foot-trefoil are both much commoner here than in the other sub-communities, and are joined by Yarrow and occasionally by Lady's Bedstraw. Ragwort is often present. The other typical U1 herbs are still frequent, especially Mouse-ear Hawkweed. Harebell *Campanula rotundifolia* is slightly preferential. Some of the typical mosses can occur, and can reach quite high cover (especially *Rhytidiadelphus squarrosus*), but lichens are usually not well represented. U1d is likely to be reasonably widespread across lowland Britain. NVC floristic table: average 17 species per sample; range 6–28.

U1e *Galium saxatile-Potentilla erecta* sub-community is described by Rodwell (1992) as being composed of Sheep's Fescue and Common Bent, with small amounts of Wavy Hair-grass and Sweet Vernal-grass. Heath Bedstraw and Tormentil are common and characteristic, with occasional Mouse-ear Hawkweed, Ragwort, Common Bird's-foot-trefoil and Common Mouse-ear. Sheep's Sorrel also remains frequent, but the other annual and ephemeral species characteristic of U1c are much rarer. Small plants of Heather and gorse spp. may occur. Mosses and lichens are poorly represented. Due to the presence of Heath Bedstraw and Tormentil, the sub-community is closely related to U4, and the two are sometimes difficult to distinguish, especially in closed swards where Sheep's Sorrel may not be visible. However, usually at least a few annuals are present, including for example, Early Hair-grass, which helps separate U1e from U4. NVC floristic table: average 14 species per sample; range 9–32.

Although samples of U1e mapped in Rodwell (1992) were widely distributed over the country, it seems to be relatively rare in the south and east. In my experience, examples of acid grassland with Heath Bedstraw and Tormentil in southern England usually have Sheep's Sorrel absent and so could be recorded as the closely similar U4. However, as also noted by Sanderson (1998), U4 is really a distinctive type of moist acid grassland of the north and west, especially in semi-upland areas and is probably over-recorded in the south. The sensible approach is probably to record examples in the south and east that resemble U4 as U1e, even if Sheep's Sorrel and other annuals are at low frequency or appear to be absent. In Hampshire, I have come across U1e/U4 grassland in Botley Wood, Havant Thicket and Blendworth Common near Horndean. In the New Forest, it is fairly widespread but its habitat is mostly occupied by U3 (Neil Sanderson, pers. comm.).

U1f *Hypochaeris radicata* sub-community is characterised by the abundance of hemicryptophytes and other rosette-leaved species, especially Cat's-ear, Lesser Hawkbit, Ribwort Plantain and often also with Buck's-horn Plantain and Common Centaury. It is difficult to get a feel for the sub-community from the NVC account, which was based on only 16 samples and mentions several anomalous species which may not be characteristic of the sub-community as a whole (such as Early Hair-grass and English Stonecrop). However, it is clear that U1f is a common and widespread type, possibly even the commonest type of U1 grassland in southern England, being especially distinctive of grazed and mown sites on pony fields, road verges and unimproved garden lawns. However, in terms of its floristics it is quite similar to U1d and these two can sometimes be difficult to distinguish. Like U1d it often occurs in transitions to MG5. Neil Sanderson (pers. comm.) notes that generally the U1d and U1f assemblages merge on the more mesic soils in the south and west. Only in the east of England is it possible to see U1d without any floristic elements from U1f, where the soils are drier and more acidic. NVC floristic table: average 15 species per sample; range 7–27.

U1f is typically dominated by mixtures of Red Fescue (often more abundant than Common Bent), Sweet Vernal-grass and Yorkshire-fog, with Squirrel-tail Fescue appearing on bare areas in spring. Soft Brome may be more frequent here than in other sub-communities. Other occasional to locally frequent herbs include dandelions and Lesser Trefoil. Winter annuals are relatively poorly represented. Common Bird's-foot-trefoil should occur at

much lower frequency than in U1d (except in the intermediate examples referred to above). Wild Thyme *Thymus drucei* is mentioned as being present in one of the NVC samples, but is probably rare in this sub-community outside of the Brecks. However, both this and Large Thyme *T. pulegioides* occur in what is probably this sub-community along some of the dry road verges in the New Forest where there is a strong calcareous influence. Sanderson (1998) noted that annual *Trifolium* and *Lotus* species are also characteristic of some stands but are not represented in the NVC samples (Knotted Clover is one such species). In transitions to MG5 my own data indicates that species such as Bulbous Buttercup *Ranunculus bulbosus*, Red Clover *Trifolium pratense*, Field Woodrush and Selfheal *Prunella vulgaris* start to appear. Rodwell (1992) mentioned a few bryophytes which can attain high cover in some stands, such as *Polytrichum* spp. and *Hypnum cupressiforme* var. *lacunosum*, but lichens are usually scarce.

U2 *Deschampsia flexuosa* grassland

Distribution and general characteristics

As noted earlier Wavy Hair-grass *Deschampsia flexuosa* requires a certain degree of soil moisture, so seldom occurs in open grassland in southern and eastern England. Rodwell (1992) notes that it is occurs 'through the upland fringes and moderately oceanic parts of the lowlands' and gives more detail on the moisture requirements and conditions for it to become established. In the south and east it is usually replaced by U1 (e.g. U1e on heathy soils).

The community is strongly dominated by Wavy Hair-grass, with other grasses present only at low cover and frequency, most commonly Fine-leaved Sheep's-fescue *Festuca filiformis* and Common Bent. Heathy acid grassland herbs may also be present, especially Heath Bedstraw and Tormentil. Heather is constant in the community, 'usually as sparse shoots but sometimes absent altogether' (Rodwell 1992), thus distinguishing it from the related heath communities. Bryophytes and lichens may be frequent to abundant, particularly those associated with heathland and moorland.

Only one of the two sub-communities is likely to occur in the south (U2a – see below). The other (U2b) is a more strictly upland type in areas of higher rainfall, characterised by the additional presence of Bilberry *Vaccinium myrtillus* and Crowberry *Empetrum nigrum*. In Hampshire and other parts of the south-east U2 is probably very localised on areas with moister soils and usually only occurs as small stands on ungrazed sites. With grazing it is likely to be converted to U1e or U4 (Sanderson 1998).

Sub-communities

U2a *Festuca ovina-Agrostis capillaris* sub-community is dominated by Wavy Hair-grass, with frequent Fine-leaved Sheep's-fescue, Common Bent, Heath Bedstraw and Tormentil. Sheep's Sorrel is a distinctive associate. Other vascular plants listed in the NVC floristic table include Common Sorrel *Rumex acetosa*, Rosebay Willowherb *Chamaenerion angustifolium*, Creeping Soft-grass *Holcus mollis*, Bracken and bramble. Seedlings or saplings of oak *Quercus* and birch *Betula* species may also occur. Typical mosses include *Polytrichum piliferum*, *Dicranum scoparium* and *Campylopus introflexus*. NVC floristic table: average 9 species per sample; range 3–16.

U3 *Agrostis curtisii* grassland

Distribution and general characteristics

This community is straightforwardly characterised by the dominance of Bristle Bent *Agrostis curtisii*, often in association with Fine-leaved Sheep's-fescue. Bristle Bent is associated with heathland habitats in south-west England and the community is characteristic of sites where certain conditions of climate, past management and soil type prevail. Rodwell (1992) gives a very detailed account of its ecology. He noted that some 'large stands' occur

U3 acid grassland dominated by Fine-leaved Sheep's-fescue *Festuca filiformis* and Bristle Bent *Agrostis curtisii* in ungrazed heathland at Browndown Common, Gosport, August 2017.

in the southern parts of the New Forest, but it is also probably widespread elsewhere in Hampshire, though sometimes present only as small patches or thin strips associated with paths and tracks on heathland sites. No sub-communities are distinguished in the published NVC but Neil Sanderson (pers. comm.) notes that it certainly has a '*Danthonia decumbens-Agrostis capillaris*' lowland sub-community here, versus a '*Vaccinium myrtillus*' sub-community in the south-west 'uplands'. NVC floristic table: average 15 species per sample; range 7–22.

Unless very well grazed, Bristle Bent characteristically grows as discrete tussocks, giving a distinctive appearance to the vegetation and allowing a moderately species rich assemblage of typical heathland plants to occupy the gaps between. Other constant species in the community are Heath Grass, Tormentil, Heath Bedstraw and Heather. Occasional to frequent species include Common Bent, Purple Moor-grass, Mat-grass *Nardus stricta*, Pill Sedge, Heath Milkwort and Cat's-ear. The floristic table also lists a number of other grasses, together with most of the heathy shrubs and dwarf shrubs, Bracken, various mosses and two Cladonias. However, only 18 samples were used to compile the data and there are a large number of other common heathland vascular plants, bryophytes and lichens that can sometimes occur, such as Umbellate Hawkweed *Hieracium umbellatum*, Sand Spurrey and Heath Groundsel *Senecio sylvaticus*.

Where stands are clearly dominated by Bristle Bent the community is straightforward to distinguish, but it often forms transitions to other types of heathy acid grassland. After burning it can become co-dominant with Purple Moor-grass, which Rodwell suggests should be considered a grassy form of **M25** *Molinia caerulea-Potentilla erecta* mire. It also forms mosaics with the dwarf shrub heath communities with which it is associated, especially where heathers and gorse are regenerating after past burning.

U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland

Distribution and general characteristics

U4 is primarily a community of upland or semi-upland acid grassland in areas of high rainfall and accounts for the majority of species poor *Festuca-Agrostis* grassland in western and northern Britain. Unsurprisingly, therefore, it was much better sampled in the NVC dataset than were other acid grassland types. The constant species are Common Bent, Sweet Vernal-grass, Sheep's Fescue (s. lat.), Tormentil and Heath Bedstraw. Most of the other typical grasses and herbs of heathy habitats mentioned in the Introduction can also occur, but one of the sub-communities is distinctive of semi-improved situations and may support a range of mesotrophic grasses and herbs. The community is mostly associated with heathland and moorland, and may therefore also include heathers, gorse and Bracken. Mosses are usually sparse but may be locally abundant, with *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum* being the most common. Typically the vegetation is short and well grazed, with little bare ground.

Five sub-communities are described in the NVC chapter, of which two: **U4d** *Luzula multiflora-Rhytidiadelphus loreus* sub-community and **U4e** *Vaccinium myrtillus-Deschampsia flexuosa* sub-community are confined to the uplands and not dealt with here. The other three occur in the damper south-west but are probably absent from Hampshire and other parts of the south-east, except maybe in the New Forest. Suspected examples of U4 in the county are more likely to be U1e (see comments above) or a variant of **U20a**, described below. Brief notes on three of the five sub-communities are given below.

Sub-communities

U4a Typical sub-community is a species poor sward composed of the constant species, sometimes with Red Fescue replacing Sheep's Fescue, and occasionally Velvet Bent *Agrostis canina* and Yorkshire-fog present. Heath Grass may be conspicuous, but occurs at low cover. Other slightly preferential graminoids include Field Woodrush and Pill Sedge. The NVC account mentions Common Dog-violet, Ribwort Plantain, Heath Speedwell and Yarrow as being fairly frequent, with Common Bird's-foot-trefoil, Lady's Bedstraw, White Clover and Common Mouse-ear occasional as scattered individuals. NVC floristic table: average 22 species per sample; range 7–62.

This type can probably be considered the northern counterpart of U1b. It is interesting to note that the average of 22 species per sample compares with only 13 for U1b, but the figure for U1b is probably a little too low, due to under-sampling of annual species, as noted above. The maximum 62 species per sample for U4a is clearly anomalous.

U4b *Holcus lanatus-Trifolium repens* sub-community is the most mesotrophic of the three sub-communities described here and distinctive of semi-improved examples. Sheep's Fescue is replaced by Red Fescue and in addition to co-dominant Common Bent occurs with Yorkshire-fog, Cock's-foot *Dactylis glomerata*, Crested Dog's-tail *Cynosurus cristatus* and Smooth Meadow-grass *Poa pratensis*. Perennial Rye-grass *Lolium perenne* can also occur. The heathy grasses are scarce or absent. Tormentil and Heath Bedstraw are much less common, whilst Yarrow, White Clover and Common Mouse-ear are much more frequent than in U4a. Other occasional herbs include Ribwort Plantain, Common Sorrel, Common Dog-violet, Lady's Bedstraw, Common Bird's-foot-trefoil, Selfheal, Dandelion and Daisy. NVC floristic table: average 20 species per sample; range 11–39.

U4c *Lathyrus montanus [Lathyrus linifolius]-Stachys betonica* [*Betonica officinalis*] sub-community is described as being dominated by Sheep's Fescue (occasionally with some Red Fescue) and Common Bent, with very common Sweet Vernal-grass. The other pasture grasses are no more than occasional, but species of calcareous grassland, such as Meadow Oat-grass *Avenula pratensis*, Crested Hair-grass and Quaking-grass *Briza media* are fairly frequent. Heath Grass and Field Woodrush are also locally frequent, with Spring Sedge being preferential at low frequencies. Strongly preferential herbs are Bitter-vetch *Lathyrus linifolius*, Betony *Betonica officinalis* and Devil's-bit Scabious *Succisa pratensis*, whilst the community constants, Tormentil and Heath Bedstraw may be patchy or scattered in occurrence. Others mentioned in the NVC account include Common Dog-violet, Common Sorrel, Ribwort Plantain, Yarrow and Meadow Buttercup *Ranunculus acris*. NVC floristic table: average 28 species per sample; range 18–42. This is the most species rich of all the U4 sub-communities.

U20 *Pteridium aquilinum-Galium saxatile* community

Distribution and general characteristics

This community provides a useful means of classifying stands of grassy vegetation that have become invaded by and often dominated by Bracken *Pteridium aquilinum*. The NVC account states that the cover of Bracken is more than 25% and notes that the fronds may reach 2 metres or more in height, so that stands often become impenetrable later in the season (as any vegetation surveyor is well aware of!). The ecology and management of Bracken is well studied, due to the economic impact it can have on hill farming in the north and west. Rodwell provides a thorough review in the NVC chapter (though some of the information may be out of date now), and he also describes the various relationships with other types of vegetation.

Species rich U20 acid grassland (perhaps transitional to U4c) on private land at Blendworth Common, Horndean, June 2018. The orange colour is mostly formed by abundant stems and flowers of Slender St John's-wort *Hypericum pulchrum*. Tormentil *Potentilla erecta* formed a creeping ground layer.

Two of the sub-communities are not relevant here; they are **U20b** *Vaccinium myrtillus-Dicranum scoparium* sub-community, which is mainly a type found on heathlands and **U20c** Species poor sub-community which is the type strongly dominated by Bracken, particularly in woodland settings. The remaining type (U20a, see below) is found in more open, grassy situations within heathlands or in areas of recently clear-felled woodland on acid soils, and forms mosaics and transitions with other types of acid grassland. It is widespread over Britain generally.

In addition to Bracken, the community constants are Sheep's Fescue (s. lat.), Heath Bedstraw and Tormentil, with Common Bent and Sweet Vernal-grass also very frequent, and Creeping Soft-grass *Holcus mollis* often characteristic. Most of the other heathy acid grassland herbs are also represented, as well as some mesotrophic grassland species. Bluebell *Hyacinthoides non-scripta* and other vernal woodland field layer species which are characteristic of **W25** *Pteridium aquilinum-Rubus fruticosus* scrub may be present, but usually not prominent in the vegetation, except for Common Dog-violet. Mosses may be varied, with *Hylocomium splendens*, *Pleurozium schreberi*, *Dicranum scoparium* and *Hypnum cupressiforme* agg. being the most common and widespread, though mainly associated with the U20b sub-community.

Sub-communities

U20a *Pteridium aquilinum-Galium saxatile* community, *Anthoxanthum odoratum* sub-community is a species poor to moderately species rich community composed of Sheep's Fescue s.lat. (probably largely *F. filiformis*), Common Bent, Sweet Vernal-grass and occasional Yorkshire-fog. A variety of other grasses may occur more sporadically, including Wavy Hair-grass, Heath Grass and Bristle Bent. Pill Sedge and Field Woodrush are occasional and slightly preferential to this sub-community. Locally frequent to occasional herbs include Common Dog-violet, Common Sorrel and Germander Speedwell *Veronica chamaedrys*. Others recorded for this sub-community include Sheep's Sorrel, Wood Sage *Teucrium scorodonia*, Common Bird's-foot-trefoil, Pignut *Conopodium majus*, Selfheal and Eyebright *Euphrasia* agg. The NVC account also notes that Harebell is frequent and Lady's Bedstraw occasional, but these two species may be more distinctive of the sub-community in the north (where Lady's Bedstraw is less restricted to calcareous grassland as it is in the south). On more mesotrophic soils there are records for White Clover, Yarrow, Meadow Buttercup, Creeping Buttercup *Ranunculus repens* and Ribwort Plantain. NVC floristic table: average 19 species per sample; range 5–65.

Rodwell notes that thistles *Cirsium arvense* and *C. vulgare* can become abundant in disturbed stands and Rosebay Willowherb *Chamerion angustifolium* is sometimes prominent after fires. Other species of disturbed examples will presumably include Ragwort and Foxglove *Digitalis purpurea*.

Mosses mentioned for the community above are occasional, but more distinctive of this sub-community are *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus*.

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